UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	WATER RESOURCES ENGINEERING
COURSE CODE	:	BFW40103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019/ JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) With the aid of a sketch diagram, explain the definition of river basin.

(4 marks)

(b) There are some issues with regards to water resources in Malaysia such as river water quality and land use management. As a water engineer, propose **THREE (3)** solutions to the problems mentioned.

(5 marks)

(c) Malaysia has implemented Integrated Water Resources Management (IWRM) in managing river basin. Do you think it is the best practice? Compose your opinion with relevant examples.

(6 marks)

(d) A bungalow development is proposed in Kluang with the inclusion of a rainwater harvesting system in the design. Average annual rainwater yield is 99 m^3. Roof area of each bungalow is 200 m^2 with a car porch and garden. The bungalow is designed with four rooms with a twin sharing concept. Each room is equipped with one dual flush toilet. The rainwater demand for domestic application is tabulated in **TABLE Q1(d)**. Given that domestic water demand is 240 litre/capita/day and average annual rainwater yield (AARY) is 116 m^3, compute:

i) Annual rain water demand

(6 marks)

ii) Rainwater tank size

(2 marks)

iii) Percentage of rainwater yield over rainwater demand

(2 marks)

Q2 (a) With the aid of diagram, differentiate between on-site detention (OSD) and on-site retention (OSR).

(5 marks)

(b) Universiti Tun Hussein Onn Malaysia has experienced several water shortage problems. With a systematic schematic diagram, propose a secondary water supply system that utilizes rainwater or groundwater as alternative water sources.

(5 marks)

(c) Discuss **THREE (3)** challenges of Integrated Flood Management (IFM) concept in managing water resources especially in the country.

(6 marks)

(d) Alor Gajah catchment with an area of 102.8 km^2 consists of 40% resident areas (C = 0.75), 30% industrial areas (C = 0.86), and 30% plantation estate and farms (C = 0.21). Estimate the peak flow rate for 5 and 50 years return period using modified rational method. Assume channel length is 10 km, average velocity is 4.5 m/s and average slope of 2%. Given $I_5 = 40\frac{mm}{hr}$ and $I_{50} = 55\frac{mm}{hr}$. (Conversion: 1 km^2 = 100 ha).

(9 marks)

Q3 (a) Illustrate the relationship between flood storage capacity, active storage capacity and dead storage capacity.

(5 marks)

(b) A portion of the inflow hydrograph to a reach of channel is in **TABLE Q3(b)**. If the travel time is K = 1 unit and the weighting factor is X = 0.50, compute the outflow from the reach for the period shown in the table.

(8 marks)

(c) A reservoir covers an area of 650 km^2 and has an average depth of 14.3 m. The inflow to the reservoir is from a river with an average flowrate of 1900 m^3/s and a suspended sediment concentration of 230 mg/L. Assume that the accumulated sediment has a bulk density of 1600 kg/m^3.

i) Evaluate the lifespan of the reservoir if no maintenance work is carried out until it less than 50% of the reservoir capacity. Refer **FIGURE Q3(c)**.

(8 marks)

ii) Based on the above result, suggest a solution to secure the water resource problem.

(4 marks)

Q4 (a) Mismanagement of irrigation system could lead to several problems. Explain in details **FOUR (4)** problems related to the irrigation system.

(8 marks)

(b) Based on **TABLE Q4(b)**, estimate the probability that the annual maximum discharge Q will exceed 10 m^3/s at least once within the next 5 years.

(8 marks)

(c) Comment on the benefits of installing an automatic irrigation system in residential or commercial landscape.

(9 marks)

-END OF QUESTIONS-

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TABLE Q1(d) Rainwater Demand for Domestic Application (DID, 2009)

Use (Appliance)	Type	Average Consumption	Average Total Rainwater Demand
A. Indoor			
Toilet	Single Flush	9 litres per flush	120 litres per day
	Dual Flush	6 or 3 litres per flush	40 litres per day
Washing Machine	Twin Tub (Semi- auto)		40 litres per wash
	Front Loading		80 litres per wash
	Top Loading		170 litres per wash
Dishwasher	-		20-50 litres per load
General Cleaning	-	10-20 litres per minute per wash	150 litres per day
B. Outdoor			
Sprinkler or Handheld Hose		10-20 litres per minute	1000 litres per hour
Drip System			4 litres per hour
Hosing Paths/Driveways		20 litres per minute	200 litres per wash
Washing Car with a Running Hose		10-20 litres per minute	100-300 litres per wash

Table Q3(b) Inflow data (m^3/s)

Time (hr)	**Inflow (m^3/s)**
0	3
1	5
2	10
3	8
4	6
5	5

Table Q4(b) Discharge data (m^3/s)

Year	**1970**	**1980**	**1990**	**2000**	**2010**
0		5.9	13.3	14.6	9.2
1	4.6	5.8	12.9	5.6	9.7
2	5.7	8.9	3.5	10.9	5.9
3	6.6	7.7	9.5	4.1	13.3
4	3.5	1.3	8.6	5.7	2.5
5	3.5	2.3	5.0	15.2	3.3
6	4.3	11.8	11.7	9.8	14.2
7	17.7	4.7	28.5	7.6	
8	10.2	7.0	5.8	4.4	
9	6.9	12.5	10.2	15.2	

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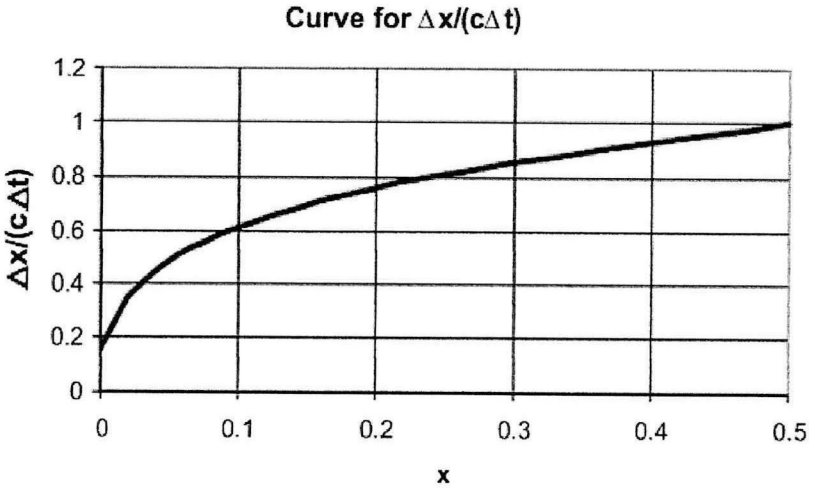

Figure Q3(c)

USEFUL EQUATIONS

$S_t = 0.01A_r$ $\quad P(X \geq x_T) = \frac{1}{T}$ $\quad P(X < x_T \text{ each year for } N \text{ years}) = (1-P)^N$

$P(X \geq x_T \text{ at least once in } N \text{ years}) = 1-(1-P)^N$

$$k = \frac{\Delta x}{c} \qquad x = \frac{1}{2}\left(1 - \frac{Q}{BS_o c\Delta x}\right)$$

$$C_1 = \frac{\frac{\Delta t}{k} + 2x}{\frac{\Delta t}{k} + 2(1-x)} \qquad C_2 = \frac{\frac{\Delta t}{k} - 2x}{\frac{\Delta t}{k} + 2(1-x)} \qquad C_3 = \frac{2(1-x) - \frac{\Delta t}{k}}{\frac{\Delta t}{k} + 2(1-x)} \qquad C_4 = \frac{2\left(\frac{\Delta t}{k}\right)}{\frac{\Delta t}{k} + 2(1-x)}$$

$$Q_{j+1}^{n+1} = C_1 Q_j^n + C_2 Q_j^{n+1} + C_3 Q_{j+1}^n + C_4 Q_L$$

$$\text{Ratio of storage} = \frac{\text{storage capacity}}{\text{annual inflow}}$$

$$Trap \quad efficiency(\%) = \frac{Se\,\text{dim}\,ent \quad amount \quad deposited}{Se\,\text{dim}\,ent \quad amount \quad entering} x\,100$$